

AD _____

MIPR NUMBER: 95MM5592

TITLE: Urination in Aviation: Evaluation of Urine Collection
Equipment for Female Aviators

PRINCIPAL INVESTIGATOR: LTC Kory G. Cornum

CONTRACTING ORGANIZATION: Armstrong Laboratories/CFT
Brooks AFB, TX 78235-5241

REPORT DATE: October 1995

TYPE OF REPORT: Final

PREPARED FOR: Commander
U.S. Army Medical Research and Materiel Command
Fort Detrick, Frederick, MD 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;
distribution unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

DTIC QUALITY INSPECTED 4

19970722 166

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE October 1995	3. REPORT TYPE AND DATES COVERED Final (23 Jan 95 - 30 Sep 95)	
4. TITLE AND SUBTITLE Urination in Aviation: Evaluation of Urine Collection Equipment for Female Aviators			5. FUNDING NUMBERS 95MM5592	
6. AUTHOR(S) LTC Kory G. Cornum				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Armstrong Laboratories/CFT Brooks AFB, TX 78235			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Commander U.S. Army Medical Research and Materiel Command, Fort Detrick, Frederick, MD 21702-5012			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)				
14. SUBJECT TERMS Defense Women's Health			15. NUMBER OF PAGES 10	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to *stay within the lines* to meet *optical scanning requirements*.

Block 1. Agency Use Only (Leave blank).

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C - Contract	PR - Project
G - Grant	TA - Task
PE - Program Element	WU - Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. (If known)

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD - See DoDD 5230.24, "Distribution Statements on Technical Documents."

DOE - See authorities.

NASA - See Handbook NHB 2200.2.

NTIS - Leave blank.

Block 12b. Distribution Code.

DOD - Leave blank.

DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.

NASA - Leave blank.

NTIS - Leave blank.

Block 13. Abstract. Include a brief (*Maximum 200 words*) factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code (*NTIS only*).

Blocks 17. - 19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

FOREWORD

Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the US Army.

____ Where copyrighted material is quoted, permission has been obtained to use such material.

____ Where material from documents designated for limited distribution is quoted, permission has been obtained to use the material.

____ Citations of commercial organizations and trade names in this report do not constitute an official Department of Army endorsement or approval of the products or services of these organizations.

____ In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and Use of Laboratory Animals of the Institute of Laboratory Resources, National Research Council (NIH Publication No. 86-23, Revised 1985).

✓ ____ For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

____ In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

____ In the conduct of research utilizing recombinant DNA, the investigator(s) adhered to the NIH Guidelines for Research Involving Recombinant DNA Molecules.

____ In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories. ...

PI - Signature

Kory G. Cornum, LTC, USAF

Date

Table of Contents

Report	Page
Introduction	1
Subjects	2
Materials	2
Methods	2
Observations	3
Discussion	4
Acknowledgment	5
References	6

URINATION IN AVIATION: EVALUATION OF URINE COLLECTION EQUIPMENT FOR FEMALE AVIATORS

Introduction

Between World War II and 1993, United States military women were blocked from flying fighter aircraft. This precluded them from participating in long duration flights in aircraft unequipped with conventional toilet facilities. Personal equipment, to include urine collection equipment, for long duration, especially single seat aircraft, has to date been designed for male specific anatomy. Examples include the flight suit (the zipper ending at the level of the penis), the condom catheter, and the standard urine collection bag ("Piddle Pack"). The law prohibiting women from flying fighter aircraft was repealed in 1991, and female pilots began training for single seat fighter aircraft in 1993. And while female aviators are now eligible by law to fly all aircraft, practical application of this opportunity is hampered by unavailability of appropriate, female anatomy specific equipment.

Anatomic differences between male and female genitourinary anatomy and voiding habits have been recognized by both the medical and aviation communities for some time. As early as 1943, different urine collection equipment requirements for male and female transoceanic aircrew were noted by Jaqueline Cochran¹. As it is for males, equipment compatible with or designed specifically for female anatomy must be convenient, inconspicuous, comfortable, and effective. There are several commercially available urine collection devices used either in clinical medicine^{2,3} or civil aviation¹. While these have been used extensively in their original settings, they have not been examined in conjunction with the other personal protective equipment used in military aviation, including the high gravity (Gz) environment. What is considered comfortable, unobtrusive, and effective in a private airplane or in a hospital, may be viewed very differently in the setting of military aviation.

Although at present women comprise less than two percent of military aviators, with expanded opportunities they may eventually account for a significant proportion. It is incumbent upon the military community to provide equipment which is compatible with the anatomy of the entire population, and potential population, of military aircrew. The purpose of this study was to identify the optimum urine collection equipment currently available for use by female military aviators, using both subjective and objective criteria. Comfort, convenience, and most importantly acceptance by the pilots of commercially available and prototype devices were assessed.

Subjects

Seven female military volunteer subjects were asked to participate in the cockpit compatibility portion of this study. The Cockpit Integration Laboratory, Armstrong Laboratory, Brooks AFB, TX was used for the USAF F-15, F-16, and A-10 fighter cockpits. Four centrifuge subjects were asked to evaluate the devices (for comfort only) while experiencing a high Gz centrifuge ride.

Following demonstration of compatibility within the laboratory, all currently deployed female fighter pilots were asked to evaluate these pieces of equipment, in conjunction with a 1.5-2.0 inch zipper extension.

Materials

The materials consisted of several bladder relief devices: the Freshette^a by Sanifem, the Lady J adapter^b ordered from Sporty's Pilot Shop, Hollister's Female Urinary Pouch (9840), Boss Product's Gal's Tote a Potty, Convenience Bag (for vomit and urine collection) from Sporty's Pilot Shop, Foley catheter, and diapers. The collection bag used is the standard issue "Piddle Pack" (bag, pilot relief, male, NSN 8105-00-922-9469)^c. Also a male condom catheter and a connector tube was used with the Lady J adapter. The flight suits were modified with an extended midline zipper^d of 1.5-2.0 inches.

Methods

All devices were discussed with a group of women pilots before testing began. Most of the devices were excluded from further testing for various reasons. Boss Product's Gal's Tote a Potty was excluded due to its large size, 8in x 4.5in x 18in. The device was too large for use in the fighter cockpit and was not inconspicuous. The Hollister Female Urinary Pouch was also eliminated before cockpit testing due to the shaving requirement and its sticky application to the female genital area. The Convenience Bag was excluded due to its shape and its incompatibility with the flight suit. The Foley catheter was not acceptable because pilots were unwilling to be catheterized before every flight and the USAF medical community was concerned about potential bladder infections and the subsequent short term removal

^a Freshette: International Sani-fem, PO Box 4117, Downey, CA 90241, (310) 928-3435

^b Lady J Adapter: Sporty's Pilot Shop, Clermont County Airport, Batavia, OH 45103-9747, 1-800-LIFTOFF(543-8633)

^c "Piddle Pack": Lighthouse Industries, Long Island City, NY 11101

^d Zippers: Scovill Fasteners Inc, PO Box 44, Clarkesville, GA 30523, 1-800-756-4734

from flight duties (grounding) due to the medical condition. Diapers, or the disposable absorption containment trunk (DACT) used by U-2 and TR-1 pilots, were also eliminated because they only contain enough liquid for one voiding (900ml)⁴. This would be a significant problem on flights lasting over four hours. Male pilots in Desert Storm routinely collected 3-4 liters of urine on 8-11 hour sorties over Iraq. Additionally, the DACT is not inconspicuous when worn under a conventional flight suit.

Two urine collection devices were found to be acceptable for further testing: the Freshette and the Lady J Adapter. Efficacy of the devices was assessed through cockpit and centrifuge testing. In the cockpit testing, subjects were asked to urinate with one of the two devices in place while sitting in a F-16, F-15 or A-10 mockup of a cockpit. The underwear was simply pulled to the side and the collection device placed under the urethra. The urine was collected in the standard male "Piddle Pack." Any urine spilled during usage was measured. Each subject wore a modified flight suit with an extended zipper and the standard CSU-13B/P anti-G suit. In the highly unlikely event that high G maneuvering would occur with the device in place, the two devices were checked for comfort in the centrifuge on a gradual and rapid Gz onset run up to 9 Gz. In addition, the exposure suit ("Poopy Suit") and the Advanced Technology Anti-G Suit (ATAGS) were analyzed for compatibility with these two urine collection devices.

Observations

The cockpit testing showed that both the Freshette and the Lady J Adapter were acceptable devices for bladder relief in-flight. Out of the eleven trials, only two had some leakage. Both times the leakage occurred with the Lady J Adapter in the F-16 cockpit; one was 100% leakage and the other was 50% leakage. The Lady J Adapter was used in the F-16 cockpit three other times with only negligible leakage. One problem is that the F-16 seat tilts back 30 degrees - both devices work by gravity flow. The other problem with the Lady J Adapter is that the condom catheter, which attaches the tubing, can kink, restricting the flow of urine. The Freshette was the most effective of the two devices with only minor leakage.

The centrifuge testing was very positive. All four women did a gradual Gz onset run up to 9 Gz plus multiple rapid onset 5-9 Gz runs during the centrifuge ride. Out of the four subjects, only one experienced some discomfort. The discomfort was only minor; it was not enough to interfere with the ride. Since the devices are made of hard plastic they have a tendency to rub against the skin. Two of the women felt the devices were more comfortable at higher Gz and that the devices were not noticeable during the centrifuge ride.

The most important observations were from the actual female fighter pilots. Both devices were given to 64%(7/11) of the

currently active female fighter pilots who were asked whether these devices were acceptable and if they would use them. These pilots were given modified flight suits and one each of the two urine collection devices. They received a briefing on our findings which included our recommendations. The response was encouraging: all of the female pilots approached readily approved of and accepted these urine collection devices. One F-16 pilot used the Freshette on a 1.5 hour cross country flight and found it to work great in the cockpit without leaks. She said this was far superior to "holding it" for four to five hours as she had done while flying over Bosnia a few months earlier.

Discussion

With Lyon's 1992 review of aeromedical considerations of women in jets came the assurance that bladder relief problems had "been addressed" with the DACT.⁵ However, the DACT is suitable only for specialized observation aircraft - not fighters. Now that women are flying long duration missions in single seat aircraft, the need exists to provide the women with a bladder relief system that, like the one for their male counterparts, is convenient, inconspicuous, comfortable, and effective. It became painfully clear that urine collection concerns had not been solved when the pilots actually deployed; preflight dehydration is not an acceptable solution. Seven commercially available urine collection devices were considered, but only two, the Freshette and the Lady J Adapter, were found to be acceptable and effective.

The standard male urine collection bag was used in this study for a very important reason. As with the men's relief system, this is the only disposable component in the women's system. The fact that it is already fielded minimizes supply problems. Also, as happened in Operation Desert Storm when units temporarily ran out of "Piddle Packs," the pilots used a water bottle as a substitute. With these two devices a water bottle can also be used as a backup collection container.

Female ground troops have used these devices for urination in the field setting too. The devices allow an inconspicuous method of urination very similar to the males. It also obviates the need to remove the clothing to the ankles in order to void in cold environments. There is one reported failure of the system in field use. An Army flight surgeon with "extreme urgency" forgot to move her underwear to the side before urination.

Although both urine collection devices are effective for in-flight bladder relief, some problems still exist. Both require practice on the part of the pilots to reduce the amount of leakage during use, they are incompatible with the current exposure suit, and the flight suit must be modified for a longer midline zipper to accommodate the female anatomy. The problems with the exposure suit and the flight suit are currently being dealt with.

All USAF female pilots in single seat aircraft are receiving an explanation of these findings along with each of the two urine collection devices for their own use. Their flight suits are also being modified with the longer midline zipper so that they can use these devices in-flight. The women will be allowed to use these devices pending development of a better bladder relief system.

Acknowledgment

The authors thank our seamstresses, Donna Jones and Laurie Farris, Krug Life Sciences, for their work in modifying the flight suit.

References

1. Rock, L.C. Report of the study group on USAF female aircrew requirement for life support and protective clothing. Wright Patterson Air Force Base, OH: Aeronautical Systems Division (Life Support SPO) ASD-TR-77-32, 1977.
2. Crawford, A.J., G.R. Plant and J. Walker. A useful device for radiology of the female outflow tract. Brit J Radiol. 57:919, 1984.
3. Steventon, R.D. Letter to the Editor, Brit J Radiol. 58:390, 1985.
4. Barlow, J.F. and S.E. Richardson. Evaluation of the disposable absorption containment trunk for female U-2 and TR-1 pilots. Aviat. Space Envir Med. 62:577-579, 1991.
5. Lyons, T.J. Women in the fast jet cockpit - aeromedical considerations. Aviat. Space Environ Med. 63:809-818, 1992.